YOLTON

Illinois Wagon Roads

Civil Engineering
B. S.
1905

ILLINOIS WAGON ROADS

BY

ROBERT ELGENE YOLTON

THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED JUNE 1905

UNIVERSITY OF ILLINOIS

May 15, 1905

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

ROBERT ELGENE YOLTON

ENTITLED ILLINOIS WAGON ROADS

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Civil Engineering

Ira O. Baker.

HEAD OF DEPARTMENT OF Civil Engineering

ILLINOIS WAGON ROADS

INTRODUCTION

It is the purpose of this thesis to discuss highway improvement in the state of Illinois from the viewpoint of the engineer. It is the intention to present the arguments without giving preference to either side of the question.

In the beginning of this thesis a brief statement of present condition of Illinois roads is made, and then follows a discussion of the attitude of the public toward highway improvement. Next, the various arguments concerning hard roads are considered and the relative importance of each is stated; and after that is an extended account of the road-building materials of the state, mention being made of the relative importance of the various materials and the location and amount of the deposits being given. State aid for wagon-road building is then briefly discussed, a summary

being given of what other states have accomplished by that method and conclusions being drawn as to what Illinois may expect from a similar plan. After the consideration of state aid there follows a short discussion on national aid, and then finally the thesis closes with a few suggestions as to what ought to be expected of a state good roads commission.

PRESENT CONDITION OF ILLINOIS WAGON ROADS

Almost all of the wagon roads of Illinois are dirt roads which are good for about nine months of the year and for the other three months they are good or bad, depending up on the condition of the weather. During the days of early spring the roads become almost impassible, but usually they do not remain long in that condition; while during the summer months the roads are usually very good. The system of drainage is poor, for but few of the roads

are properly tiled; and in the southern part of the state where the drainage is obtained entirely by means of side ditches, the ditches are improperly cared for and are suffered to fill up and thus hold the water in the road bed. In places where the road runs along a side hill, the ditch next to the hill is often not kept open and the water from that side is allowed to run across the road and to wash out deep ditches in the roadway. The surface of the road is not properly cared for, and many times large holes are dug out by the action of the wheels dropping into them, and during a rainy time these holes are filled with mud.

It is easy to see that improvement is needed; but how to make that improvement is a question not easily settled.

ATTITUDE OF THE PUBLIC TOWARD ROAD QUESTIONS

The attitude of the public toward road improvement is one of indif-

ference. The people seem to consider highway improvement as a side issue, and do not trouble themselves about the wagon roads. The men in charge of the road construction and maintenance are usually totally ignorant of the principles of road improvement and they usually do not care whether they work much or not.

There are many causes for this lack of interest in the roads, but only a few of the more important ones will be discussed.

The excellence of the railways of the state and their rapid development have done much toward keeping back the improvement of the highways. Soon after the close of the civil war the railways were being pushed into the various parts of the state, and as they offered an easy and rapid means of transit the people naturally gave their attention and money to the further development of the railway system.

The long familiarity with bad roads and the natural conservatism of the common people are other elements that help to make the public indifferent to the value of improved wagon roads. If a people has been long familiar with any evil condition, that condition will not seem bad to them until it is contrasted with something much better. The people of this state so seldom have an object lesson in good roads that they do not become enthused on the subject.

The fear of increased taxation adds to the indifference of the people, for they always look with disfavor on anything that tends to increase the taxes. It is plain that to improve the wagon roads of Illinois would require much money, which would have to be furnished by the people, and they are therefore opposed to the measure.

Finally, the system of forced labor adds to the lack of enthusiasm on road questions. Under this system the people are usually compelled to work

out at least a part of their road taxes. As a result the road has come to be a place where men see how small an amount of labor they can make count for a days work.

THE ADVANTAGES OF GOOD ROADS.

The advantages of good roads will be discussed under two distinct heads: social benefits and financial benefits. The social advantages to be derived from better highways are of much greater importance than the financial ones and hence the former will be discussed at more length.

The first of these social advantages lies in the development of better citizens. The influence of good roads begins with the individual and extends to the township, the county, and the state. From earliest infancy men are moulded by the many and various agencies with which they are surrounded; and all advance in

civilization is measured by the extension of social and commercial communications. If the daily life of any people is narrow and circumscribed, their minds will necessarily lack breadth, their thoughts will move in a narrow and winding channel, and in consequence their opinions and motives will be selfish and mean. Ambition is the spur which moves both the mind and the body to quicker efforts; the desire to excel and thus gain applause encourages people to larger work. The greater the impetus the more marked will be the result; and the better the means of communication the wider will become the circle of influence. With bad roads the public gets in to the habit of hermit life. What one community thinks, wishes, or does has no influence upon the adjoining community. The winter season, which should be the time of greatest social intercourse, is spent in seclusion; households have

but little touch with one another, and any real communal life becomes impossible.

A second social advantage derived from hard roads is that the farmer could utilize the time when the ground is not fit for cultivation, or when he is other wise at leisure, in visiting his neighbors, and in that way keep in touch with the doings of others. It is only by contact with his fellowmen that a mans faculties are aroused and his senses quickened.

There is still a third social advantage from improved highways,— the establishment of a more complete and efficient rural mail system. The government has given renewed intellectual activity to the farmers and made their lives much more pleasant by establishing free rural mail delivery, thus giving them access to the news of the world. The fact that rural mail delivery has been established on

Illinois loam roads would seem to indicate that these roads are good, for the postal service has made it a prerequisite to the establishment of a rural delivery route that the roads be placed and maintained in "good condition". There is a lack of proper inspection and many carriers will endure the worst of road condition without complaint, while the postmaster whose duty it is to report the road condition is often indifferent and careless. For these reasons, it is not correct to assume that because Illinois has free mail delivery, the roads are good. To the contrary, many of the rural routes pass over very bad roads and if the state had improved highways the entire mail system would be much improved.

The *financial benefits* to be derived from hard roads are not so important as the social benefits and hence will be more briefly discussed.

It is claimed that hard roads

would decrease the cost of transportation; and some people contend that the saving from that source would build permanently hard roads; but from certain data gathered by the author to be presented later, that advantage seems to be of minor importance. The farmer usually has time to market his grain and other products, and the real cost to him is nothing. It is very seldom that the Illinois roads are impassible for any considerable length of time, and a wait of a few days is of but little moment.

Again it is asserted that good roads would tend to equalize the traffic between the different seasons of the year, and in that way be a financial gain. Those favoring hard roads say that during the days following a prolonged period of bad weather, there is a rush to the markets and congestion follows. This may sometimes be true; but it often happens

that through lack of cars during good weather, no grain is marketed. Hence it would seem that the above argument is of comparatively little importance.

It is claimed that hard roads would give to the farmers many other advantages, but they are comparatively unimportant and will not be discussed here.

ROAD BUILDING MATERIAL

There is a wide difference of opinion in regard to the amount of road-building material in Illinois. For example, Prof. N. S. Shaler, formerly state geologist of Kentucky, at present Professor of Geology in Harvard College and Dean of Lawrence Scientific School, and for ten or twelve years President of the Massachusetts Highway Commission, who has made an investigation for the U. S. Geological Survey of the road-building material of the United

States, says that Illinois has no material that is fit for road building. On the other hand, Prof. C. W. Rolfe, Professor of Geology in the University of Illinois, a geoligist of wide experience, who has lived in Illinois a half century but who has had no experience in road building, says that Illinois has good road-building material in very large quantities. The difference in the views of these men is probably due to the difference in their experience. Professor Shaler has had his experience in road building in the state of Massachusetts where trappean rocks are very abundant; and it is easy to see that he might think any rock softer than trap would not do for macadamizing purposes. While Professor Rolfe has lived in a limestone region where trappean rocks never occur; and naturally he takes a more hopeful view, and considers the lime-

stones as very good material for road building purposes.

These are three materials that may be used in building hard roads in Illinois; viz., gravel, broken stone, and brick.

GRAVEL.— Gravel when properly applied makes an excellent road surface— not as lasting as lasting as broken stone but much superior to ordinary earth roads. To be suitable for road building purposes, gravel should be hard and tough so as to resist the impact of wheels and hoofs; the pebbles should be of different sizes, each in the proper proportion; and the gravel should contain enough binding material to cement the entire mass when placed in a road bed. Not all of the gravel found in Illinois possess the above characteristics, but owing to the fact that but little is definitely known of the various deposits, the discussion that follows will be made

quite general.

These are several small deposits of gravel of glacial origin found in the central and the northern part of the state which have been used and are still being used for road purposes. Near Gibson City in Ford County are several comparatively small pockets of gravel which have been used to good advantage in improving the wagon roads in that part of the county. The gravel seems to be of a durable character, for the roads upon which it has been used have given good service. Other deposits of glacial gravel are found in McHenry, Kane, Dupage and northern Will and Kendall counties. In all of these counties the gravel in knolls associated with the terminal moraines. In the northern part of Ogle county there is a large amount of gravel which appears in escars and knolls. In eastern Winnebago county a glacial terrace

along the Rock river affords large quantities of gravel.

A little to the south of the center of the state is a tier of counties composed of Edgar, Coles, Shelby, etc., across which stretch the terminal moraines. The quantity of gravel found here is not large, but is enough to gravel the roads in the several townships through which the moraines extend.

The counties bordering on the Ohio and Wabash rivers have a liberal supply of a light colored gravel which has abundant cementing material. This gravel has been used on the highways in that section of the state, and it has been seen that very soon after the gravel has been placed in the road beds, it cements into a hard compact mass.

Other small quantities of gravel are found on the Embarrass river in Cumberland, Jasper and Law-

rence counties, and along the Illinois river in Peoria, Fulton, Tazewell and Mason counties.

The conclusion may be drawn that the supply of gravel found in Illinois is too small to be of much moment in the hard roads proposition for the state, and if such a plan is ever carried out some other material must be used.

BROKEN STONE.— If the broken stone road is composed of good material and is well constructed it forms a very satisfactory roadway. The requirements of the stone for a broken-stone road are hardness, toughness, binding power, and resistance to the weather. The best material for road building is trap rock, for it possesses all of the above properties. Novaculite is a form of chert, and although it is hard and tough, will not resist the action of the weather. The limestones possess some binding properties, and when

formed into a road bed, make a very smooth highway; but they are too soft to be durable.

In the Ozark mountains in Missouri is found a supply of trap rock. Professor Rofle believes that it is possible that a similar deposit could be found in the hills of southern Illinois; for those hills are believed to be one terminal of the Ozark range of mountains. However, no such deposit has yet been found.

Near Cairo, Illinois, is a large supply of novaculite; and large quantities of it have been used on the roads in and around Cairo, and in Jackson, Tennessee; and in both those places it has given good satisfaction.

Novaculite was laid in Springfield less than two years ago, and about one year ago, that is after the first winter, extensive repairs were required; and the writer knows nothing of how the road has endured

traffic during the past year, but as the past winter and spring has been quite dry, the road has not had a severe test, and it is possible that it may be in good condition, although such a condition is probably due more to a favorable season than to good material. The novaculite road near Bloomington was built some five or six years ago, and deteriorated rapidly during the first winter and spring; and is now reported to be wholly destroyed and to be no better than an ordinary earth road.

The reason that novaculite gave good service in the first places and poor in the last ones is probably due to the difference in the soil and climate of the different localities. The climate of southern Illinois and western Tennessee is much less severe than that of Springfield and Bloomington, and the soil of the former places is sandy and therefore not

sticky, while that of the latter is black loam and very sticky.

The limestones of the state must furnish the material for macadamizing purposes, if Illinois ever has hard roads. Along the northern border of the state are extensive deposits of limestone, and near La Salle are other large beds of this material. The limestone of La Salle is of a durable character, and that county has already built nearly 300 miles of hard road. Many deposits of limestone are to be found along the western border of the state; and near Grafton, on Otter creek in Jersey county, is an extensive outcrop of dolomitic limestone which is not quite as good for road purposes as the trenton limestone of La Salle. Small quantities of limestone are found in Montgomery and Green counties.

Limestones occur in nearly the whole of southern Illinois, but the strata are usually so far below

the surface of the ground as not to be available for road purposes; however in Hardin county, it is reported that a deposit over 50 feet thick extends over 160 acres.

Other deposits of limestone are found in Clark and Edgar counties, but "not in large quantities".

BRICK.— The requisites for a good brick pavement are that the road bed be well drained and rolled, and that the brick be laid on a suitable foundation. The foundation may be either concrete, broken stone, gravel, or brick laid flatwise. It is the tendency now to think that the only good foundation is concrete; but experience has shown that if a broken stone or gravel foundation is well put down, the pavement is equally as good as one laid on concrete, and the cost will be much less.

But very few attempts have been made at using brick in road

construction, but since brick can be formed from most any of the clay of this state, it seems that such a hard road is not altogether out of the question.

STATE AID

Under what is known as state aid, the State pays part of the cost of the wagon road improvement. The administration of the road affairs is usually in the hands of a state commission; and the cost of building the roads is apportioned to the state, the county, and the township or the local district. A few of the states are building roads under state aid acts, and a short review of the road building in those states will next be given.

New Jersey has more hard road than any other state in the union, and most of her hard roads have been built with the help of state

aid. That state appropriates annually \$250,000 for state aid. The state pays one third of the cost and the counties two thirds, and ten per cent of the county's share may be assessed on the townships. In 1903 there had been built, or were under contract, by state aid about 960 miles of road, and there were applications made for the improvement of 480 miles more for which the state as yet had made no appropriation. In the year 1903 the average cost of gravel roads in New Jersey was \$2,543.32 per mile, and the average cost of broken stone roads was \$7,084.05 per mile.

Connecticut appropriated \$150,000 for hardening the public road in 1895, then in 1901 and 1902 that state raised \$450,000 for the same purpose. The plan of distribution of the cost there is for the state to pay two thirds, and sometimes three fourths, of the cost of the road, and the townships the se-

mainder. In 1904 there had been built or were under contract, by state aid about 450 miles of hard road.

Massachusetts in 1903 appropriated $2,250,000 for hard road purposes for a period of five years; the statute providing that not more than $450,000 be spent on the highways in any one year. There the state pays the entire cost of the road, but 25 per cent of the cost is assessed back to the counties. Up to the first of 1904 Massachusetts had built 480 miles of hard road, and petitions were on file for many miles of road for which there was no appropriation.

The state of New York appropriates $600,000 a year as state aid. The state pays 50 percent of the cost of the road construction, the counties 35 per cent, and the towns 15 per cent. About 500 miles of hard road have been built in that state, and the State Engineer has petitions for many miles of road that will have to

wait for further appropriations before they can be built.

In 1903 Pennsylvania provided for the appointment of a State Highway Commission, and appropriated $6,500,000 to be divided among the different counties as state aid in proportion to the mileage of roads in each county, and to be expended during a period of six years. Two thirds of the cost of building the roads is to be paid by the state, one sixth by the county, and one sixth by the townships which the improved highways traverse.

Several other states, viz.: Maine, New Hampshire, Rhode Island, Delaware, and California have done something toward state aid, but have not as yet taken any very decided steps in that direction.

About two years ago the State of Illinois appointed a Good Roads Commission consisting of Col. D.W. Smith

of Springfield as chairman with messrs H.U. Wallace and E.A. Mitchell as the other members. This commission was given \$5,000 with which to investigate the condition of the wagon roads of the state. It recently made a report and submitted a bill to the state legislature asking for an appropriation of \$100,000 a year for two years for state aid to wagon road building, and \$50,000 for investigations and for the expenses of the Commission.

This bill has met strong opposition from various parts of the state - especially from the farmers in the corn belt. Under the state aid bill the people throughout the entire state would be taxed to help pay for any particular piece of road; and the farmers in one locality are not in favor of helping build the highways in a region remote from them. Furthermore, the people believe that the management of the road affairs should

be left entirely to the township (or county) and that any expense for road improvement should be paid by the community directly benefitted.

In discussing state aid Illinois is frequently compared with eastern states which have had some years of experience with the state aid plan; but such a comparison is of but little value owing to the difference in conditions. In the matter of cost Illinois is often compared with those states, and the conclusion drawn that the cost of building hard roads in Illinois would not exceed the cost in the eastern states. This conclusion is not warranted, for the latter states have abundant first class road material close at hand; while, as has already been shown, the former state has but very little good road material. Then too the eastern states are thickly populated and the so-called farmers devote their time to the raising of per-

ishable products and dairying, and hence need improved highways; while Illinois is less thickly populated, and the people devote their time to raising corn, oats, hay, etc., and therefore do not need improved wagon roads.

NATIONAL AID

National Aid for wagon-road building was brought strongly before the minds of the people when in 1904 a bill was introduced into Congress known as the Brownlow Bill. That bill provided for an appropriation of $24,000,000 available at the rate of $8,000,000 a year for three years. This amount was to be divided among the different states according to their population, except for a few minor considerations. Under that bill each state, county or town receiving federal aid must add a like amount to the sum received from the United States Government. There were a number

of other provisions in the bill and its advocates claimed that it would work a great reform in the wagon roads of the United States. However, the bill failed to become a law.

National aid was first tried in the United States in 1811 when the construction of the national road to the "far west" was begun. That road started at Cumberland, Maryland, took an almost direct westerly course, and finally ended at the Mississippi river at St Louis Missouri. A large part of this national road was macadamized; but the part across Illinois was never finished, the road being left as a common dirt road, except in some of the worst places where short stretches of plank road were introduced.

The national road was at first maintained, in part at least by a system of toll houses. When the road was first opened it was the only direct route to the "new west" and was

extensively patronized. At that time the toll receipts were important; but with the advent of the railroads, the amount of toll became less, until finally a few years ago the last of the toll houses were abandoned.

Nothing more was done in the way of national aid until 1893 when Congress appropriated a small sum of money to enable the Secretary of Agriculture to make investigations of road conditions. These appropriations were continued from year to year until in 1900 when the sum of \$8,000 was appropriated for the same purpose; and in 1901 Congress apparently became more enthused on the road question and appropriated 14,000 for the Office of Public Road Inquiries; and in 1902 an appropriation of \$20,000 was made.

The advocates of national aid have been very busy during the last few years trying to arouse interest in the subject. As a result

there are many who believe that the United States should take the matter in hand and aid in the construction of better highways. Probably the chief cause for this belief grew out of the mistaken notion that by some mysterious means, the national government has at its command large sums of money for which there is no use. The people seem to forget that indirectly they must share in the entire expense, even if the nation bears half of the cost.

Finally, it may be said that nearly all of the objections raised against state aid, hold against national aid.

THE WORK OF A STATE GOOD ROADS COMMISSION

At this writing a legislative bill appointing a state good roads commission is awaiting the approval of the Govenor of the state. The writer believes that such a com-

mission could render a valuable service to the state. The following subjects might properly recieve attention.

Before any remedy can be intelligently applied it is necessary to know all the facts, and therefore the good roads commission should determine the amount of money spent for different purposes in connection with the construction and maintenance of roads and bridges. The Commission appointed in 1903 presented some statistics on the subject; but they are so inaccurate as to be misleading. For instance, the Commission quotes a table showing the road and bridge tax assessed in the several counties; and also gives a table showing the county aid for bridges. The two sums are added and the total called the cost of the wagon roads; whereas the difference of the two sums is the

real expenditure for roads. The data for the report were obtained in an unsystematic way and many blunders as the above are the result.

Again, before the financial advantages of any proposed road improvement can be determined, it is necessary to know the cost of wagon transportation under present conditions; and therefore a state good roads commission should gather statistics as to the weight of load hauled at different seasons of the year, the length of haul, the cost per ton mile, etc. This investigation should be made with exceeding care as otherwise the results are likely to be misleading. For example, the U. S. Road Inquiry Office has made an investigation and in its Circular No. 19 gave 5.5 miles as the length of haul and 23 cents the cost per ton mile; while Professor Baker in his investigation found both the above values

to be excessive. The author has inquired into the road conditions in Fayette county, and has found the cost per ton mile to be practically nothing since the farmers market their crops at a time when they have nothing else to do, and also found the weight of the loads hauled in one season were practically the same as in another. These three investigations were carefully made, yet they differ widely; and hence the need of extreme care on the part of the Commission.

If the Governor approves the present bill, the new Commission will be given money with which to build experimental sections of road, which is a wise plan, for by so doing a real test of the various materials can be made. However the Commission should go farther and investigate the nature and amount of the various deposits of road-building

material in the the state. For example, it is known that deposits of gravel exist in various localities, but it is a fact that not all of these deposits are fit for road purposes, and hence more definite knowledge should be had on the subject. Likewise, some limestones are more suited to road building than others, and the Commission could advantageously make experiments to determine the relative value of the stone from various localities.

The people will never appreciate fully their relation to the highways of the state until they have become educated on the subject. The Commission could employ some one who is a fluent speaker and well versed in the science of road building, to go about the state and tell the people how to build good roads. Such a man could visit the farmers institutes and like gatherings and

awaken intelligent interest on road questions.

In conclusion then it may be said that upon the new Commission rests a great responsibility, for the recent road agitation has aroused the people and they are going to demand reliable results.

Finis